ECE 480A7: Introduction to Quantum Computing

IN

Logic Gates and Microprocessors

- Basic knowledge of electronic logic gates and microprocessors is required. Basic knowledge of semiconductors is an asset in this course.

Computer Programming

- Basic knowledge of programming in Python or other language(s).

Linear Algebra

- Knowledge of linear algebra, matrix decompositions, rotation operators, matrix invertibility is required.

Pre-requisites

- ECE102 with a minimum grade of C; MATH369 with a minimum grad of C

Concepts:

- Introduction to Quantum Computing
- How Quantum Computing Differs from Classical Computing
- Overview of Linear Algebra
- Quantum States and Entanglement
- Quantum Gates
- Universal Quantum Algorithms
- Leading Qubit Modalities, Qubit Robustness
- Superconducting Qubit Quantum Computers
- Photonics Quantum Computers
- Trapped-Ion Quantum Computers
- IBM Quantum Computer
- Quix Quantum Computer
- Quantum Error Correction
- Quantum Computing and Industry Perspectives
- Quantum Algorithms and Their Potential Speed-Up
- Quantum Communication and Encryption, Quantum Key Distribution

Applications:

- Quantum Computing
- Quantum Optimization
- Quantum Security
- Quantum Communication

Tools:

- GUI tools to access IBM and Quix quantum computers (on cloud)

OUT

What is Quantum Computing?

- Understand how quantum computing differs from classical computing and why there is increasing interest in quantum computing.
- Grasp the basic concepts of qubits, quantum states, entanglement, etc.

How to Build Quantum Computers?

- Learn about fundamental quantum gates.
- Explore various platforms for realizing quantum computers, including superconducting, trapped-ion, and photonic quantum computers. Understand the advantages and disadvantages of each type.

Hands on Experience with Quantum Computers

- Hands-on experiment in implementing quantum algorithms on state-of-the-art quantum computers available on the cloud (IBM and Quix).

Industry Perspective

- Learn about how quantum computers can solve problems that classical computers cannot and gain insights from an industry perspective.

Revised 2/2024